

CLAIMS

1. A semiconductor device comprising an insulating film, the insulating film being formed of an insulative inorganic material as a main material, the insulative inorganic material containing silicon and at least one kind of element other than silicon, and the insulating film containing hydrogen atoms, wherein the absorbance of infrared radiation of which wave number is in the range of 3200 to 3500 cm^{-1} is 0.02 or less when the insulating film to which an electric field has never been applied is measured with Fourier Transform Infrared Spectroscopy at room temperature.
2. The semiconductor device as claimed in claim 1, wherein the insulating film includes a plurality of particular structures of atomic groups each of which is constructed from hydrogen and the at least one kind of element other than silicon and in which a hydrogen atom is bonded to an atom of the at least one kind of element other than silicon, wherein the absorption of the infrared radiation having the wave number within the range is derived from the plurality of particular structures of the atomic groups.
3. The semiconductor device as claimed in claim 1, wherein the at least one kind of element other than silicon includes oxygen.
4. The semiconductor device as claimed in claim 3, wherein the at least one kind of element other than silicon further includes at least one of nitrogen, hafnium, zirconium, and aluminum in addition to oxygen.
5. The semiconductor device as claimed in claim 1, wherein each hydrogen atom in at least a part of the hydrogen atoms is replaced by a deuterium atom.

6. The semiconductor device as claimed in claim 1, wherein the average thickness of the insulating film is 10 nm or less.

7. The semiconductor device as claimed in claim 1, wherein the semiconductor device includes a gate electrode and a gate insulating film for insulating the gate electrode, and the gate insulating film is formed from the insulating film.

8. The semiconductor device as claimed in claim 7, wherein the semiconductor device is adapted to be used under the condition that a gate voltage is applied to the gate electrode so that the electric field intensity in the insulating film is 10 MV/cm or less.

9. The semiconductor device as claimed in claim 7, wherein a leakage current passing through the gate insulating film in the thickness direction thereof that is measured in a state that the gate voltage is applied to the gate electrode so that the electric field intensity in the insulating film is 5 MV/cm or less is 9×10^{-9} A/cm² or less.

10. The semiconductor device as claimed in claim 7, wherein the total amount of electrical charges passing through the gate insulating film in the thickness direction thereof until a soft breakdown occurs in the insulating film is 40 C/cm² or more.

11. The semiconductor device as claimed in claim 7, wherein the total amount of electrical charges passing through the gate insulating film in the thickness direction thereof until a hard breakdown occurs in the insulating film is 100 C/cm² or more.

12. The semiconductor device as claimed in claim 1, wherein the Fourier Transform Infrared Spectroscopy is Multi-Reflection Attenuated Total Reflection Method.

13. An electronic device comprising the semiconductor device defined by claim 1.

5 14. An electronic apparatus comprising the electronic device defined by claim 13.